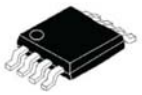
LM2903

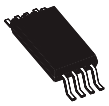
Low-power dual voltage comparator

Datasheet - production data

D
SO8
(plastic micropackage)



S
MiniSO8
(plastic micropackage)



P
TSSOP8
(thin shrink small outline package)

DFN8 2x2 mm
(plastic micropackage)

Related products

- See the LM2903W for similar devices with higher ESD performances
- See the LM2903H for similar devices with operating temperature up to 150 °C

Features

- Wide single supply voltage range or dual supplies +2 V to +36 V or ±1 V to ±18 V
- Very low supply current (0.4 mA) independent of supply voltage (1 mW/comparator at +5 V)
- Low input bias current: 25 nA typ.
- Low input offset current: ±5 nA typ.
- Input common-mode voltage range includes negative rail
- Low output saturation voltage: 250 mV typ. (I_O = 4 mA)
- Differential input voltage range equal to the supply voltage
- TTL, DTL, ECL, MOS, CMOS compatible outputs
- Automotive qualification

Description

This device consists of two independent low-power voltage comparators designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

In addition, the device has a unique characteristic in that the input common-mode voltage range includes the negative rail even though operated from a single power supply voltage.

This is information on a product in full production. www.st.com

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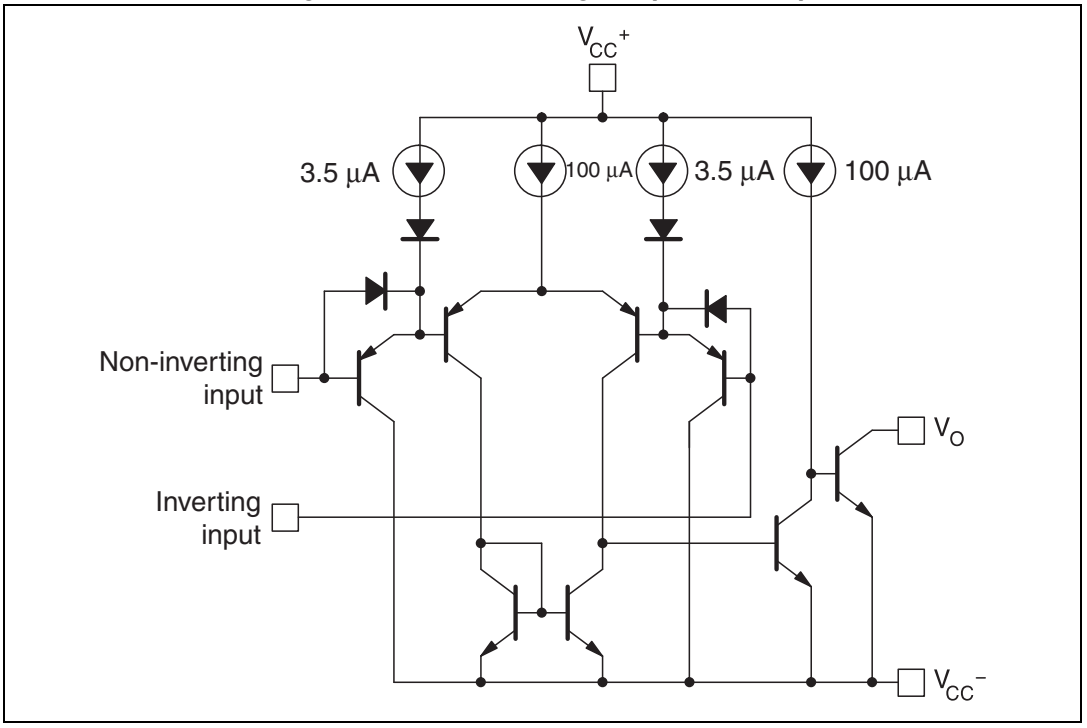
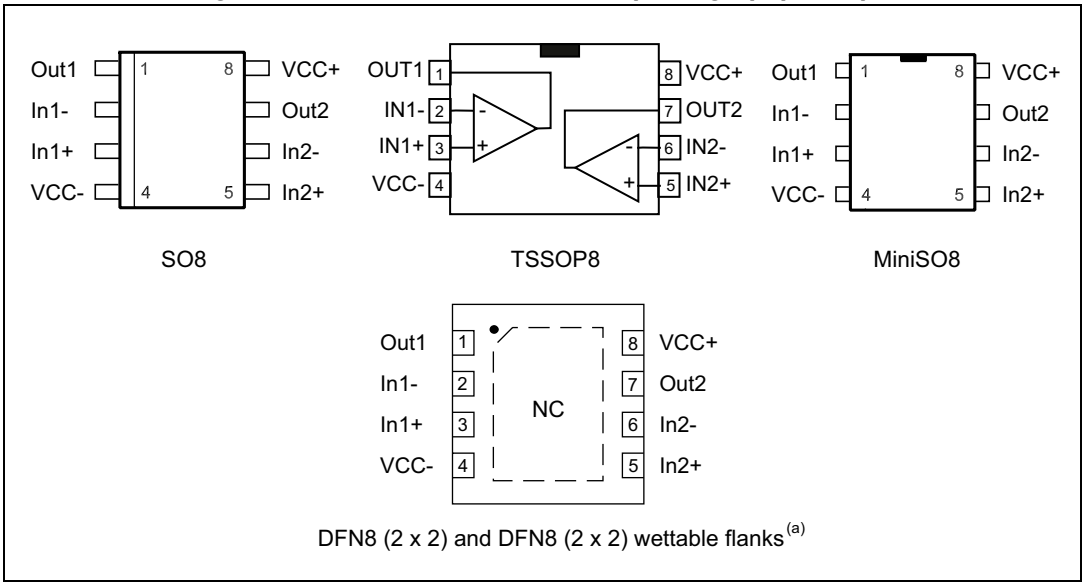
1 Schematic diagram

Figure 1. Schematic diagram (1/2 LM2903)



2 Package pin connections

Figure 2. Pin connections for each package (top view)[a]



a. Exposed pad can be left floating or connected to ground.

3 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	±18 or 36	V
V_{id}	Differential input voltage	±36	
V_{in}	Input voltage	-0.3 to +36	
	Output short-circuit to ground (1)	Infinite	
R_{thja}	Thermal resistance junction to ambient(2) SO8 TSSOP8 MiniSO8 DFN8 2x2 mm	 125 120 190 57	°C/W
R_{thjc}	Thermal resistance junction to case(2) SO8 TSSOP8 MiniSO8 DFN8 2x2 mm	 40 37 39 57	
T_j	Maximum junction temperature	+150	°C
T_{stg}	Storage temperature range	-65 to +150	
ESD	Human body model (HBM)(3)	800	V
	Machine model (MM)(4)	200	
	CDM: charged device model (all packages except MiniSO8)(5)	1.5	kV
	CDM: charged device model (MiniSO8)	1.3	

1. Short-circuits from the output to V_{CC}^+ can cause excessive heating and possible destruction. The maximum output current is approximately 20 mA, independent of the magnitude of V_{CC}^+.
2. Short-circuits can cause excessive heating and destructive dissipation. Values are typical.
3. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are left floating.
4. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are left floating.
5. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{icm}	Common mode input voltage range $T_{min} \leq T_{amb} \leq T_{max}$	0 to V_{CC}^+ -1.5 0 to V_{CC}^+ -2	V
T_{oper}	Operating free-air temperature range	-40 to +125	°C

4 Electrical characteristics

Table 3. V_{CC}^+ = 5 V, V_{CC}^- = GND, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage(1) $T_{min} \le T_{amb} \le T_{max}$		1	7 15	mV
I_{io}	Input offset current $T_{min} \le T_{amb} \le T_{max}$		5	50 150	nA
I_{ib}	Input bias current(2) $T_{min} \le T_{amb} \le T_{max}$		25	250 400	
A_{vd}	Large signal voltage gain V_{CC} = 15 V, R_L= 15 kΩ, V_o= 1 to 11 V	25	200		V/mV
I_{CC}	Supply current (all comparators) V_{CC} = 5 V, no load V_{CC} = 30 V, no load		 0.4 1	 1 2.5	mA
V_{id}	Differential input voltage(3)			V_{CC}^+	V
V_{OL}	Low level output voltage (V_{id} = -1 V, I_{sink} = 4 mA) $T_{min} \le T_{amb} \le T_{max}$		250	400 700	mV
I_{OH}	High level output current (V_{CC} =V_o = 30 V, V_{id} = 1 V) $T_{min} \le T_{amb} \le T_{max}$		0.1	 1	nA µA
I_{sink}	Output sink current (V_{id} = -1 V, V_o = 1.5 V)	6	16		mA
t_{res}	Small signal response time(4) (R_L = 5.1 kΩ to V_{CC}^+)		1.3		µs
t_{rel}	Large signal response time(5) TTL input (V_{ref} = +1.4 V, R_L= 5.1 kΩ to V_{CC}^+) Output signal at 50% of final value Output signal at 95% of final value			 500 1	 ns µs

1. At output switch point, $V_O \approx$ 1.4 V, R_S = 0 Ω with V_{CC}^+ from 5 V to 30 V, and over the full input common-mode range (0 V to V_{CC}^+ –1.5 V).
2. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference of input lines.
3. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator provides a proper output state. The low input voltage state must not be less than –0.3 V (or 0.3 V below the negative power supply, if used).
4. The response time specified is for a 100 mV input step with 5 mV overdrive.
5. Maximum values are guaranteed by design and evaluation.

Figure 3. Supply current vs. supply voltage

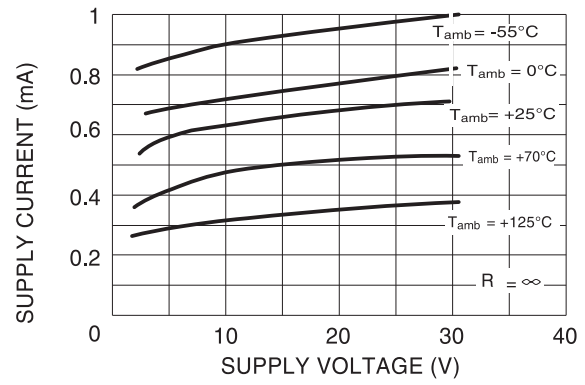


Figure 4. Input current vs. supply voltage

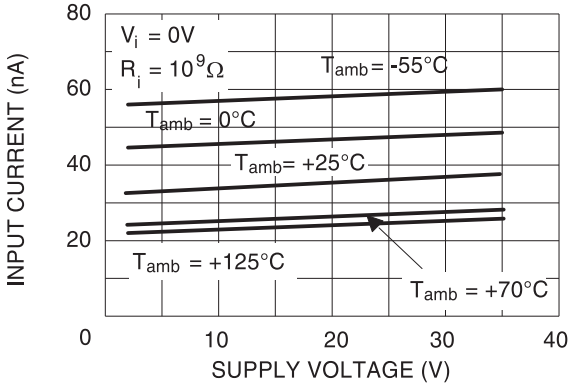


Figure 5. Output saturation voltage vs. output current

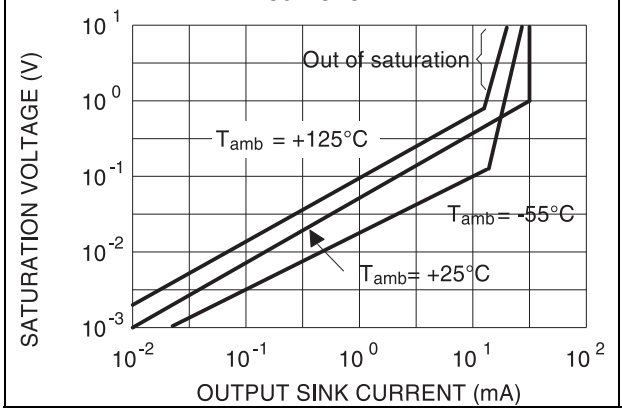


Figure 6. Response time for various input overdrives - negative transition

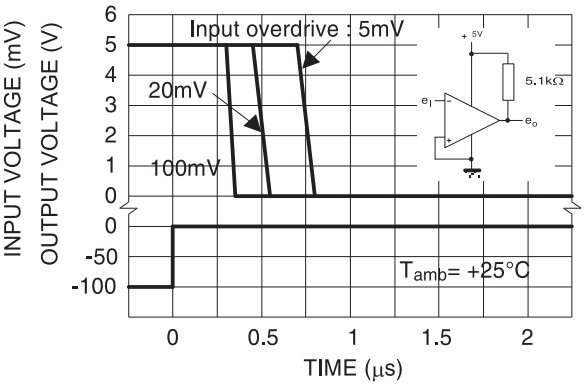
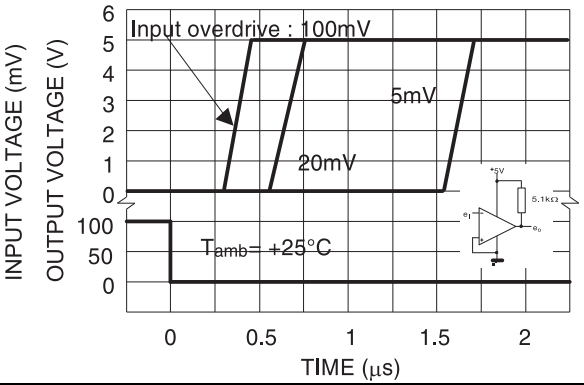


Figure 7. Response time for various input overdrives - positive transition



5 Typical application schematics

Figure 8. Basic comparator

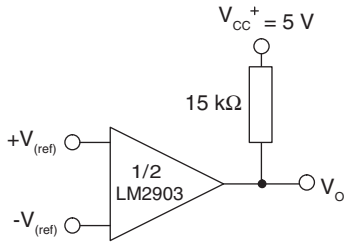


Figure 9. Driving CMOS

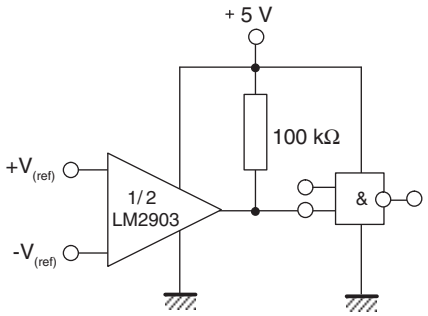


Figure 10. Driving TTL

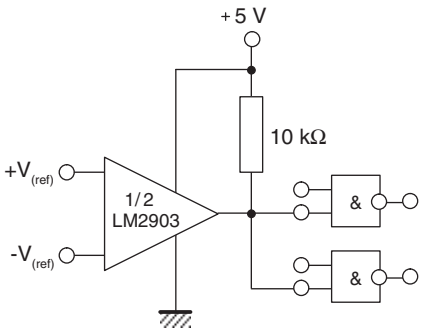


Figure 11. Low frequency op-amp

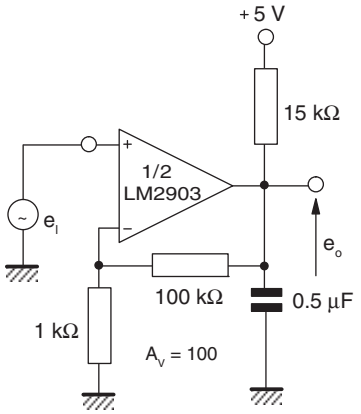


Figure 12. Low frequency op-amp with boost

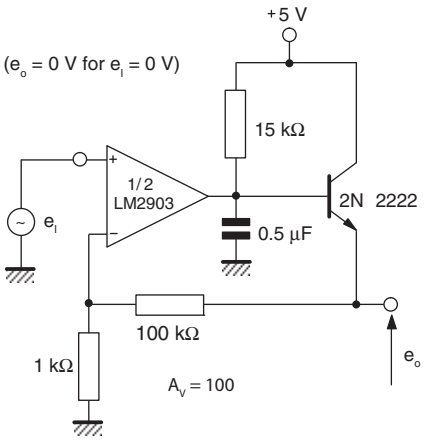


Figure 13. Transducer amplifier

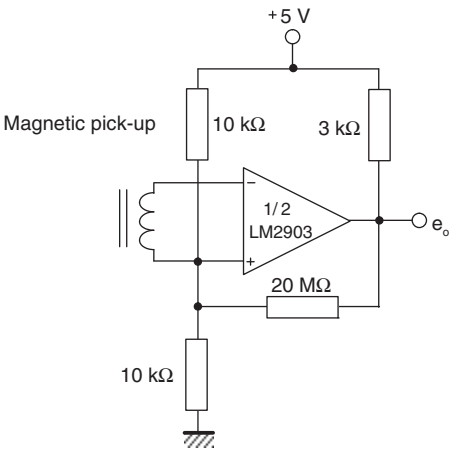


Figure 14. Low frequency op-amp with offset adjust

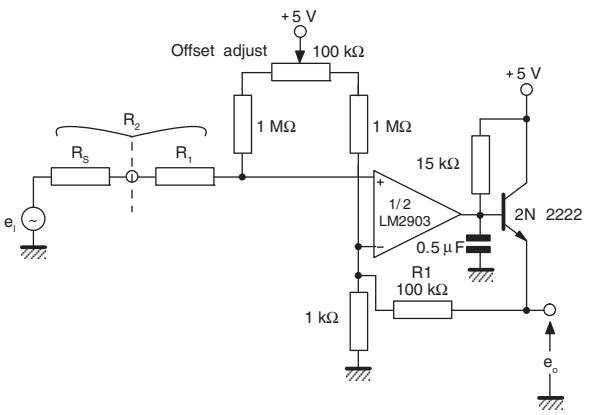


Figure 15. Zero crossing detector (single power supply)

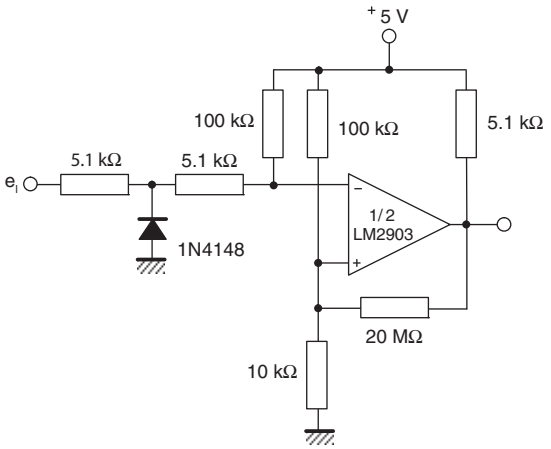


Figure 16. Limit comparator

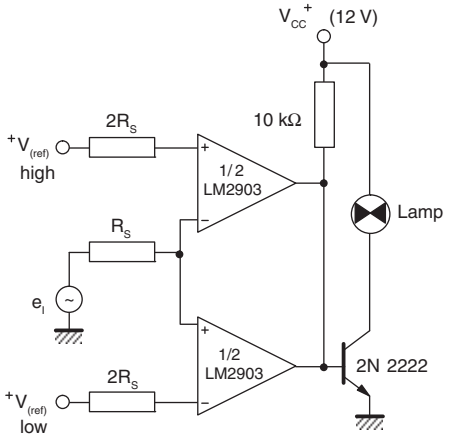


Figure 17. Split-supply applications - zero crossing detector

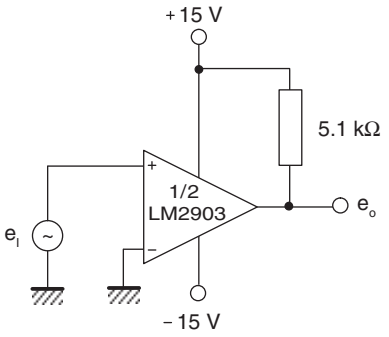


Figure 18. Crystal controlled oscillator

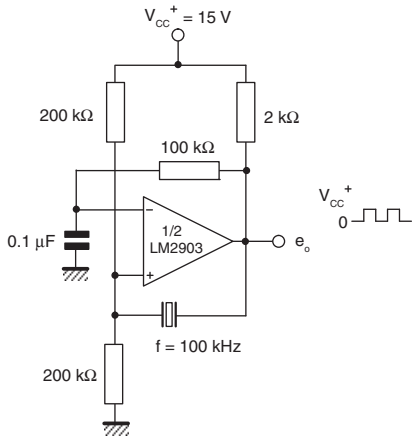


Figure 19. Comparator with a negative reference

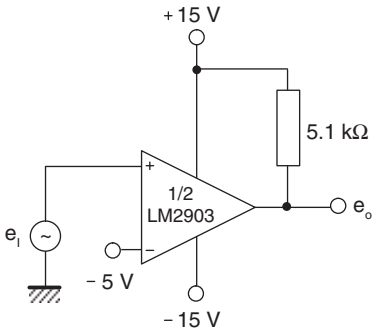


Figure 20. Time delay generator

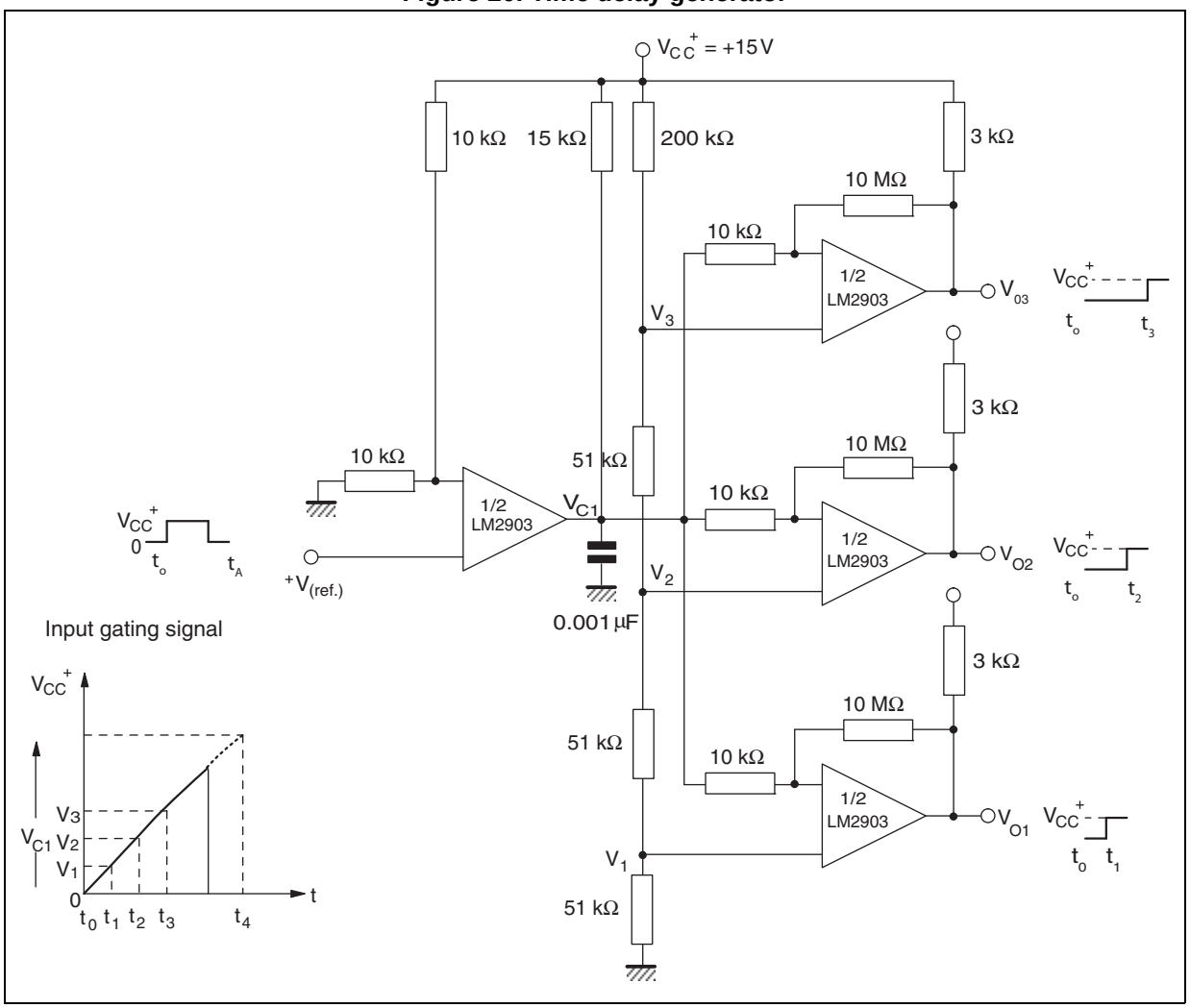
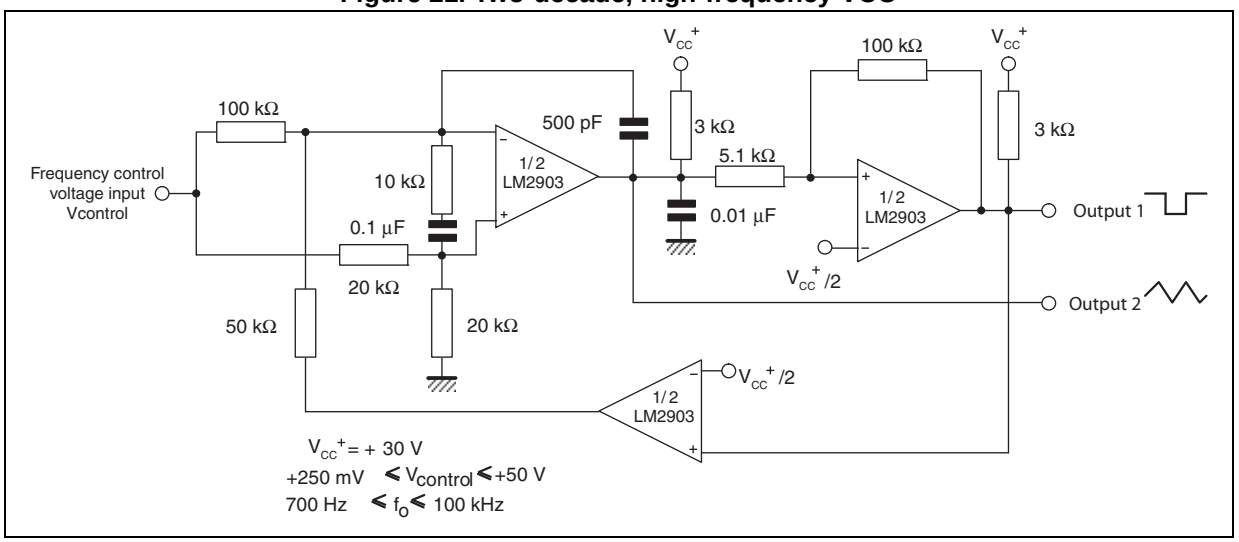


Figure 21. Two-decade, high-frequency VCO



6 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.
ECOPACK® is an ST trademark.

6.1 SO8 package information

Figure 22. SO8 package mechanical drawing

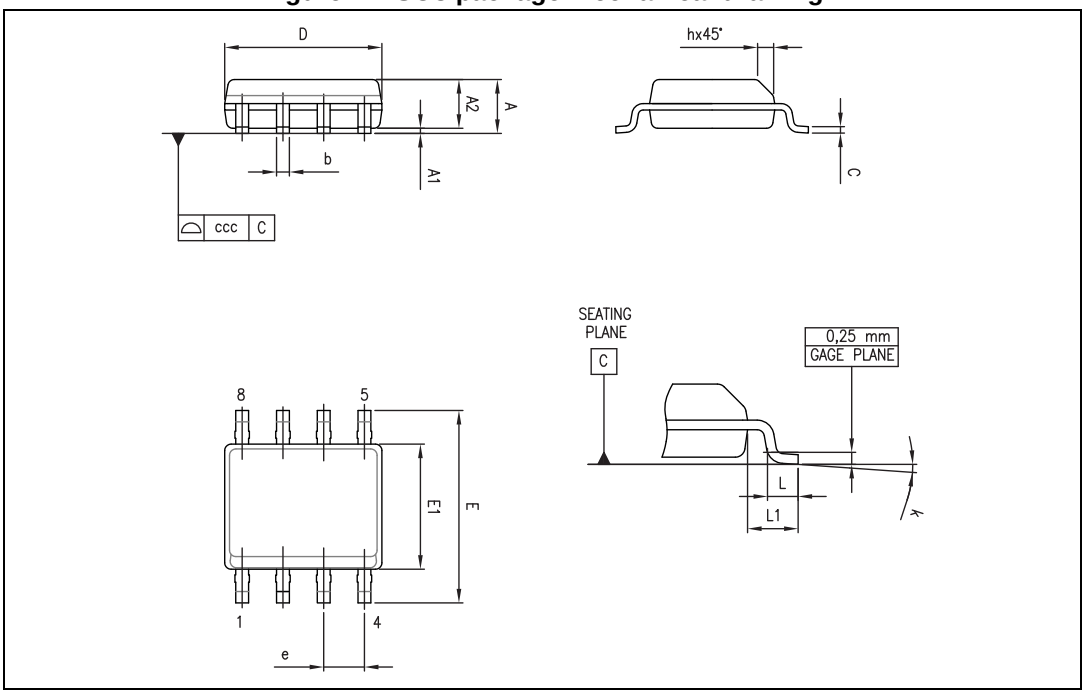


Table 4. SO8 package mechanical data

Ref.	Dimensions					
	mm			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.10		0.25	0.004		0.010
A2	1.25			0.049		
b	0.28		0.48	0.011		0.019
c	0.17		0.23	0.007		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
L1		1.04			0.040	
k	1°		8°	1°		8°
ccc			0.10			0.004

6.2 TSSOP8 package information

Figure 23. TSSOP8 package mechanical drawing

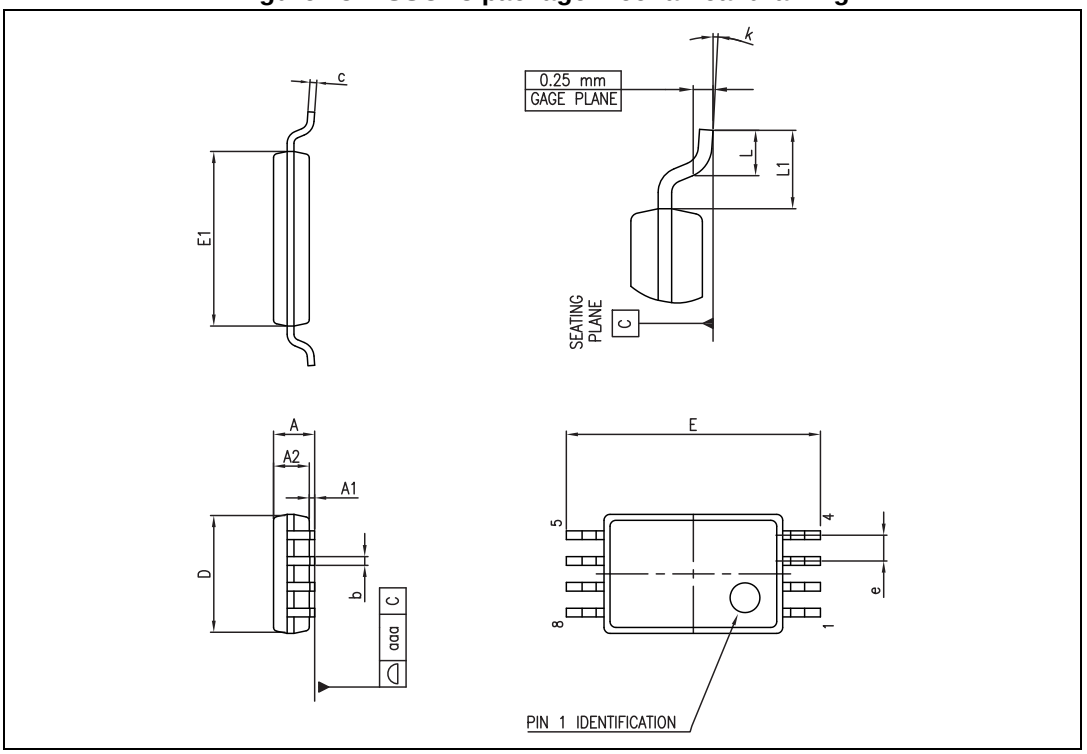


Table 5. TSSOP8 package mechanical data

Ref.	Dimensions					
	mm			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.047
A1	0.05		0.15	0.002		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.008
D	2.90	3.00	3.10	0.114	0.118	0.122
E	6.20	6.40	6.60	0.244	0.252	0.260
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.0256	
k	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1		1			0.039	
aaa			0.10			0.004

6.3 MiniSO8 package information

Figure 24. MiniSO8 package mechanical drawing

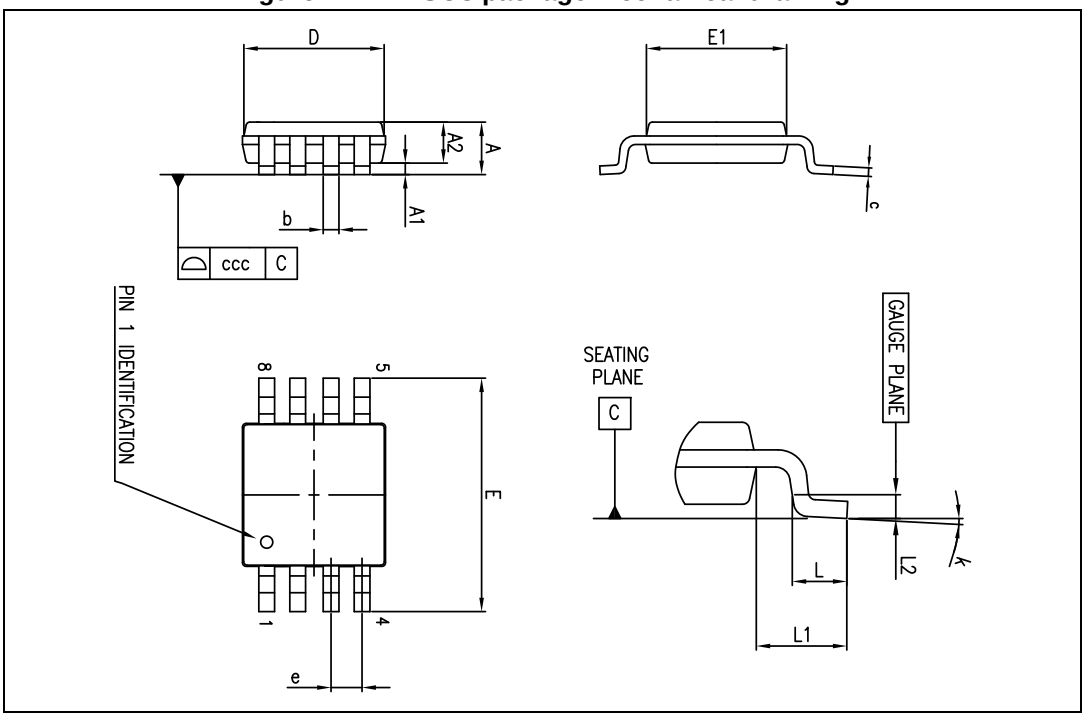


Table 6. MiniSO8 package mechanical data

Ref.	Dimensions					
	mm			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.1			0.043
A1	0		0.15	0		0.006
A2	0.75	0.85	0.95	0.030	0.033	0.037
b	0.22		0.40	0.009		0.016
c	0.08		0.23	0.003		0.009
D	2.80	3.00	3.20	0.11	0.118	0.126
E	4.65	4.90	5.15	0.183	0.193	0.203
E1	2.80	3.00	3.10	0.11	0.118	0.122
e		0.65			0.026	
L	0.40	0.60	0.80	0.016	0.024	0.031
L1		0.95			0.037	
L2		0.25			0.010	
k	0 °		8 °	0 °		8 °
ccc			0.10			0.004

6.4 DFN8 2x2 package information (LM2903Q2T)

Figure 25. DFN8 2x2x0.6 mm package mechanical drawing (pitch 0.5 mm)

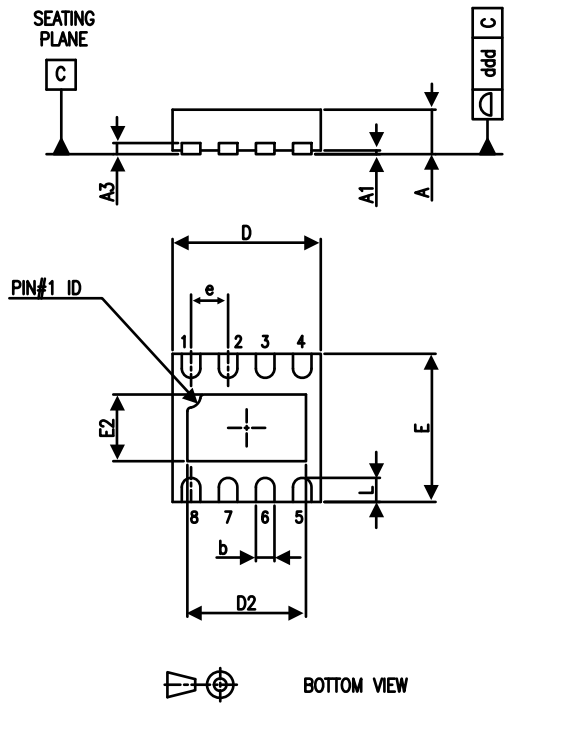
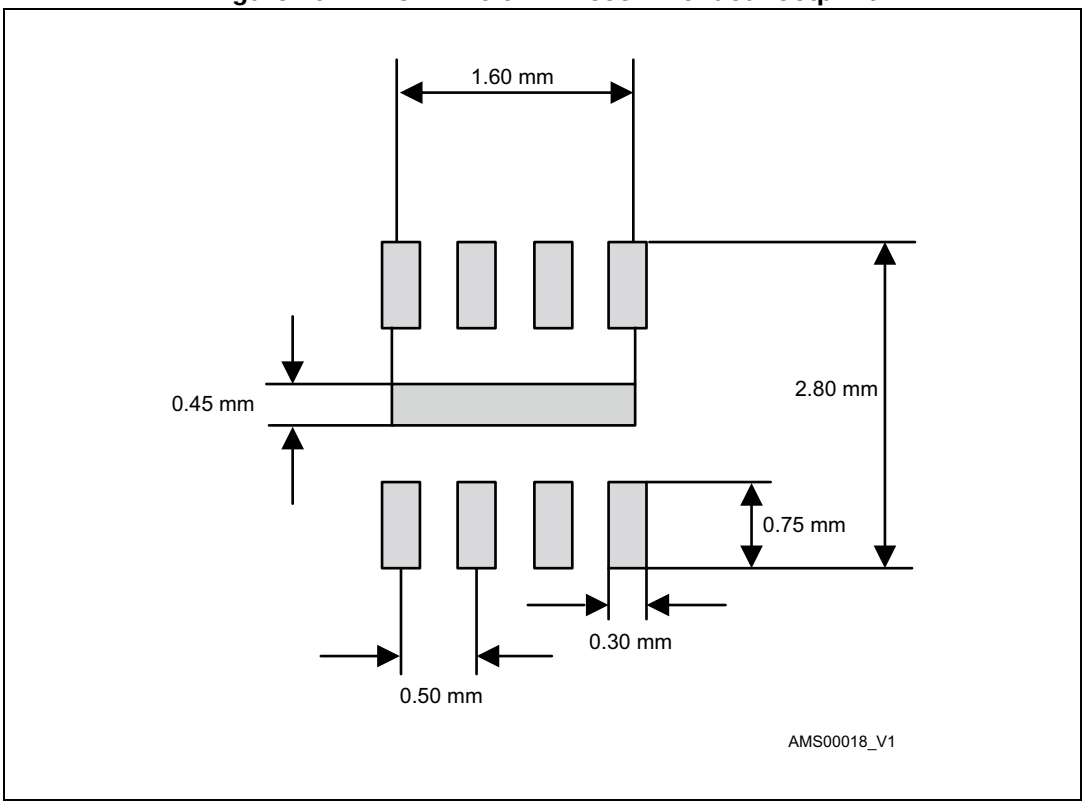


Table 7. DFN8 2x2x0.6 mm package mechanical data (pitch 0.5 mm)

Ref.	Dimensions					
	mm			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.51	0.55	0.60	0.020	0.022	0.024
A1			0.05			0.002
A3		0.15			0.006	
b	0.18	0.25	0.30	0.007	0.010	0.012
D	1.85	2.00	2.15	0.073	0.079	0.085
D2	1.45	1.60	1.70	0.057	0.063	0.067
E	1.85	2.00	2.15	0.073	0.079	0.085
E2	0.75	0.90	1.00	0.030	0.035	0.039
e		0.50			0.020	
L			0.50			0.020
ddd			0.08			0.003

Figure 26. DFN8 2x2x0.6 mm recommended footprint



6.5 DFN8 2x2 package information (LM2903YQ3T)

Figure 27. DFN8 2x2 mm wettable flanks package outline

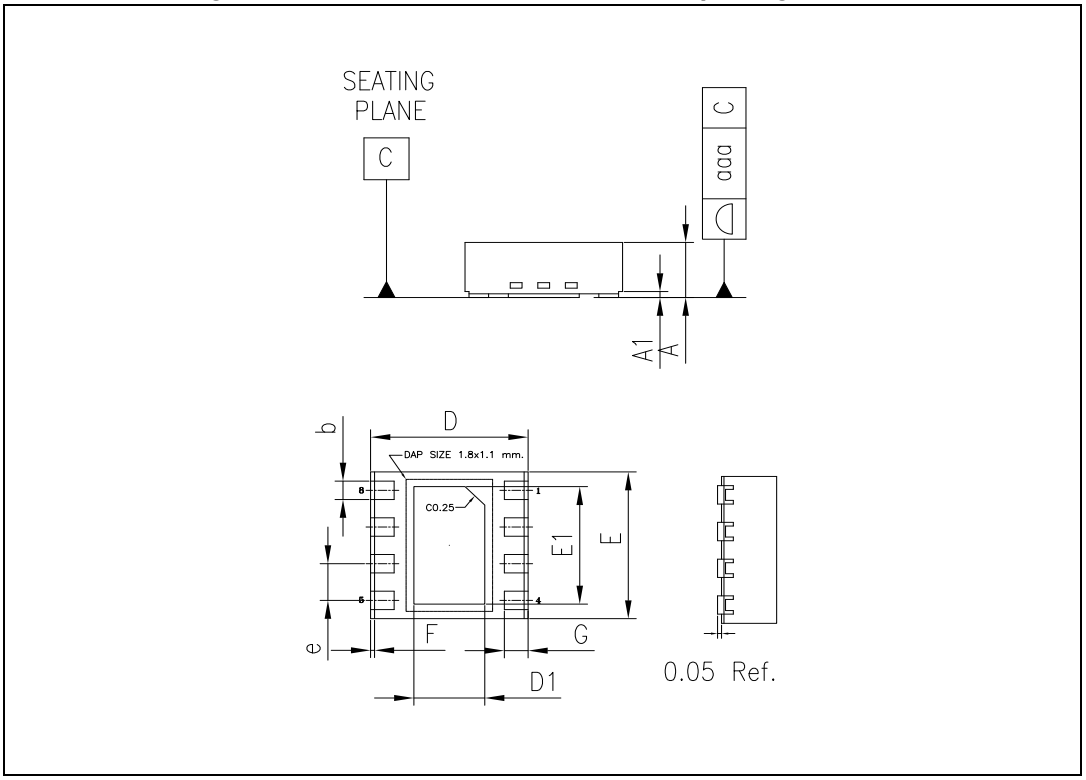


Table 8. DFN8 2x2 mm wettable flanks package mechanical data

Ref.	Dimensions					
	mm			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.70	0.75	0.80	0.027	0.029	0.031
A1		0.10			0.003	
b	0.20	0.25	0.30	0.007	0.009	0.011
D	1.95	2.00	2.05	0.076	0.078	0.080
D1	0.80	0.90	1.00	0.031	0.035	0.039
E	1.95	2.00	2.05	0.076	0.078	0.080
E1	1.50	1.60	1.70	0.059	0.062	0.066
e		0.50			0.019	
F		0.05			0.001	
G	0.25	0.30	0.35	0.009	0.011	0.013
aaa		0.10			0.003	

7 Ordering information

Table 9. Order code

Order code	Temperature range	Package	Packing	Marking
LM2903D/DT	-40 °C to +125 °C	SO8	Tube or tape and reel	2903
LM2903YDT(1)		SO8 (automotive grade)	Tape and reel	2903Y
LM2903PT		TSSOP8		2903
LM2903YPT(1)		TSSOP8 (automotive grade)		2903Y
LM2903ST		MiniSO8		K431
LM2903YST(1)		MiniSO8 (automotive grade)		K419
LM2903Q2T		DFN8 2x2 mm		K1Z
LM2903YQ3T(1)		DFN8 2x2 mm wettable flanks		K5M

1. Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent.

8 Revision history

Table 10. Document revision history

Date	Revision	Changes
15-Jun-2003	1	Initial release.
2-May-2005	2	PPAP references inserted in the datasheet see table order code p1.
8-Aug-2005	3	Electrical characteristics table corrected (see *Table 3 on page 5*). Pin connections diagram moved to cover page. Lead-free package information added.
27-Oct-2005	4	PPAP part number added in *Table 9: Order codes*.
11-May-2007	5	ESD tolerance added in T*able 1: Absolute maximum ratings on page 4*.
17-Jan-2008	6	Added R_{thja} and R_{thjc}, and ESD CDM parameters in T*able 1: Absolute maximum ratings*. Removed V_{icm} from electrical characteristics in *Table 3*. Reformatted package information in *Section 6*. Added footnotes for automotive grade parts in *Table 9: Order codes*..
21-Feb-2008	7	Corrected SO-8 package mechanical data. Dimension E in drawing was marked H in table. Corrected revision history (revision 6 is of January 2008, not January 2007).
03-Dec-2009	8	Added pin description on cover page.
16-Feb-2012	9	Removed LM2903YD order code from *Table 9*.
05-Dec-2012	10	Added the DFN8 package Small modifications to *Figure 2* and *Table 1*.
21-Nov-2013	11	Added MiniSO8 package Added Related products *Table 1*: updated R_{thjc} and CDM information for MIniSO8 *Table 9*: added order code LM2903YST for MiniSO8 (automotive grade). Updated disclaimer
15-Nov-2017	12	Added new RPN LM2903YQ3T *Table 9: Order codes*, and new *Section 6.5: DFN8 2x2 package mechanical data (LM2903YQ3T)*. Removed DIP8 package.
08-Oct-2018	13	Updated *Section 7: Ordering information*.

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